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OUR CRITICS AND THEIR VIEWPOINTS.*

By J. H. Minnick.

The purpose of this paper is to present the viewpoints of those who criticize present practices in the teaching of mathematics. It has been impossible to make an exhaustive study of the criticism against mathematics. This discussion is therefore limited to the work of a few men whose viewpoints, it is believed, may be considered as representative. We shall consider representatives from three classes of school men; namely, university professors, state superintendents, and men active in local school systems. The facts have been gathered from letters written by critics in response to our inquiries, and from their published works. We shall try to give a fair statement of these facts free from the influence of our personal opinion.

Professor Frank M. McMurry, of Teachers College, has expressed his views concerning mathematics in the *Teachers College Record* of March, 1903.† "Business utility and mental discipline," he says, "should not rank as the primary aims in teaching mathematics. . . . The child's interest in the quantitative side of life should be the highest immediate aim of the teacher of mathematics in the grades. . . ." The subject matter should be selected in accordance with the child's nature and with a view to meeting social needs. As we understand Professor McMurry, mathematics is to be used as a means for the quantitative interpretation of life and as such must be taught in close relation to the affairs of life. In answer to our letter of inquiry Professor McMurry says: "I have frequently suggested criticism of mathematics on the grounds that it deals with the processes, without reference to the purposes of those processes. For example, outside of educational institutions people continually work problems for the sake of getting the answers. In arithmetic and algebra, however, the student is expected to disregard the answer, practically, even though working for it. That situation seems remarkably artificial."

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* Read at the spring meeting of the Association.

† The chapter "Controlling Ideas Throughout the Curriculum" was written chiefly by Professor McMurry.

In his letter replying to our inquiry, Professor W. H. Kilpatrick makes three points clear: (1) he would not justify mathematics in secondary education only on the basis of formal discipline; (2) he would differentiate the courses in mathematics to meet the needs of various groups of children, and (3) he believes that the amount of mathematics should be decidedly less than is now taught in the secondary schools of our country. He says: ". . . if we follow the logic of our present thinking along the line of formal discipline, it seems to me, then, that we are compelled to question seriously the traditional high-school mathematics. I cannot see for my own part why we need one tenth as much of the geometry as is offered, except possibly for those who are specializing in mathematics for research purposes. It further seems to me that if we consider the needs of the various groups of users, we must give up the notion of teaching algebra in one form to all."

A severe criticism against present practices in mathematics is offered by Henry C. Morrison, superintendent of public instruction of New Hampshire in an article entitled "Reconstructed Mathematics in the High School" and published in The Thirteenth Yearbook, Part I., of the National Society for the Study of Education. He maintains that there is general dissatisfaction with the results of mathematical instruction. He then attempts to analyze the situation with a view to determining the cause of the failure of mathematics and the remedy for this failure. He finds three factors in the educational problem; namely, the child, social needs, and the subject-matter by means of which the child can be adjusted to these social needs. Mathematics, he maintains, has failed for two reasons. First, it can not be made to function in the child's life. "It not only does not function in the hands of a poor teacher," says he, "but it cannot even in the hands of the skilled teacher. That is to say, there is nothing to which most processes in algebra or geometry, or indeed arithmetic, can be applied except to more algebra or arithmetic." Nevertheless Mr. Morrison suggests an array of mathematical subjects such as the teacher of mathematics would scarcely dare propose in the face of present-day criticism. For the domestic science course he suggests arithmetic and mechanical drawing; for the agricultural course, geometry, trigonometry and algebra; for the commercial course, science of accounts, higher arithmetic and algebra; and for the mechanic arts course he suggests geometry, plane trigonometry, analytic geometry and calculus. It is difficult to see why such subjects should be included in a high-school course if the present course has failed because mathematics can not be made to function "even in the hands of the skilled teacher." The second cause of failure is the fact that our mathematics is not suited to the nature of the adolescent. It seems that his objection here is to drill work as well as to the formal side of mathematics. He declares that the period of adolescence "is the worst period between the shedding of milk teeth and the grave for anything like drill."

Mr. Morrison offers a remedy for the failure of mathematics. "In the first place," he says, "the traditional round of algebra, geometrical logic, advanced algebra, and trigonometry ought to be entirely abandoned and a fresh start made." Having thus cleared the board, he would begin the differentiation of courses with the seventh grade, this differentiation to provide courses in household arts, agriculture, mechanic arts, commerce, etc. Each course is to have its own specially organized mathematics including those elements essential to the work of that course. Further the mathematics of each course should probably be taught by the teachers in charge of the course rather than by a special mathematics faculty.

Another criticism of interest comes from Dr. Snedden, commissioner of the Massachusetts State Board of Education. In a letter* to the committee appointed by the Association of Mathematical Teachers in New England to investigate current criticism on high-school mathematics Dr. Snedden proposes the following questions:

"1. What are, or what should be, the controlling purposes to be served by the study of algebra in the secondary schools? . . .

"2. Is it yet practicable to demonstrate either that these purposes are important for all pupils, or that they are realized in the case of many of the pupils taking the study?

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* See Preliminary Report of the Committee on the Status of Mathematics in the Secondary Schools.

"3. Are these purposes as yet so definitely formulated that it is practicable to determine how far given organizations of the materials of algebra, or given methods of teaching, results in their realization?

"4. More specifically, why should girl students in the high schools be required to take algebra before being allowed to graduate?

"5. Why should women students seeking admission to college be required to present algebra as an entrance subject?"

From these questions it seems that Dr. Snedden doubts whether, in case the purpose of mathematics were clearly defined, that purpose would be of great value to all students or whether it is realized in the case of many students. Further he believes that the prominent place now held by mathematics in the secondary schools is due to faith in "mental training" rather than its usefulness in further learning. He makes the following suggestions for a high-school course: (1) Make mathematics an elective both for graduation from the high school and for admission to college, (2) offer a course in mathematics for those students preparing for vocations which require the subject, and (3) develop a cultural course in mathematics for those who wish to inform themselves more fully about the world in which they live. "Just as many of us," he says, "can enjoy and respond to operas, epics, and great paintings, without being artists in these fields, so I think many could be led to appreciate the place of mathematics without becoming mathematicians." We leave each to draw his own conclusions concerning such a course but to us it seems to be a course in mathematics with the mathematics left out.

Associate Superintendent William McAndrew,* of the City of New York, has undertaken to investigate the results of the teaching of mathematics in the grades of the Brooklyn schools. His investigation shows that even in simple problems involving only the fundamental processes of arithmetic, accuracy has not been acquired. He shows further that with small expenditure of time in drill the efficiency of children can be greatly increased. His chief criticism is directed against the tendency to stress the process and speed at the expense of accuracy.

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* See Report upon Division 4 and 5, Elementary Schools. Department of Education, The City of New York.

William D. Lewis, in his "Democracy's High School," declares that "high-school mathematics is limited by college entrance requirements almost entirely to abstract theory and manipulative gymnastics." He claims that this course is a failure and as proof he cites the fact that the report of the New York State Education Department for 1913 shows that only 67.1 per cent. of the pupils taking the examination in mathematics passed. We note, only as a passing remark, that when judged by the same standards Italian, Latin, science and the commercial subjects are even worse failures. Mr. Lewis suggests that (1) mathematics be brought in closer relation to real life, (2) pure mathematics be reserved for the colleges, (3) more attention should be given to speed and to the accuracy of results. In answer to our letter he says: "My objection to the traditional requirements in mathematics is largely empirical. I have seen so many pupils driven out of school by work which could not by any possibility be of practical advantage to them, and I have watched so many classes in guessing, under the caption of algebra, that I have come to believe that we ought to discriminate as carefully as possible between those pupils who really need the advanced mathematics and those who will find other work more profitable."

In general our critics are agreed "that mental training is not sufficient reason for giving mathematics its present importance in the curriculum, that it should be more closely related to the affairs of life, and that the subject-matter should be better suited to the nature and needs of the pupils, which generally means that the subject should be less formal and that the course should be differentiated. However they are not fully agreed as to the extent of the mathematics which should be taught nor are they agreed as to the methods by which the purpose of mathematics is to be realized.

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